

# Dielectron Production in relativistic Au+Au-Collisions at BES Energies

Patrick Huck for the STAR Collaboration

Relativistic Nuclear Collisions Program

Central China Normal University and Lawrence Berkeley National Laboratory



## Introduction & Motivation

### RHIC Beam Energy Scan (BES) & STAR Dielectron Program

- consistently combine various signatures over a wide range of beam energies
- deconfinement and **chiral symmetry restoration** ( $\chi$ SR) are QGP characteristics
- bulk penetrating EM probes ( $\gamma$  /  $\ell^+\ell^-$ ) are ideal to access in-medium hadronic spectral functions due to their negligible rescattering in the fireball ( $\lambda_{\text{mp}} \gg \tau_{\text{FB}}$ )

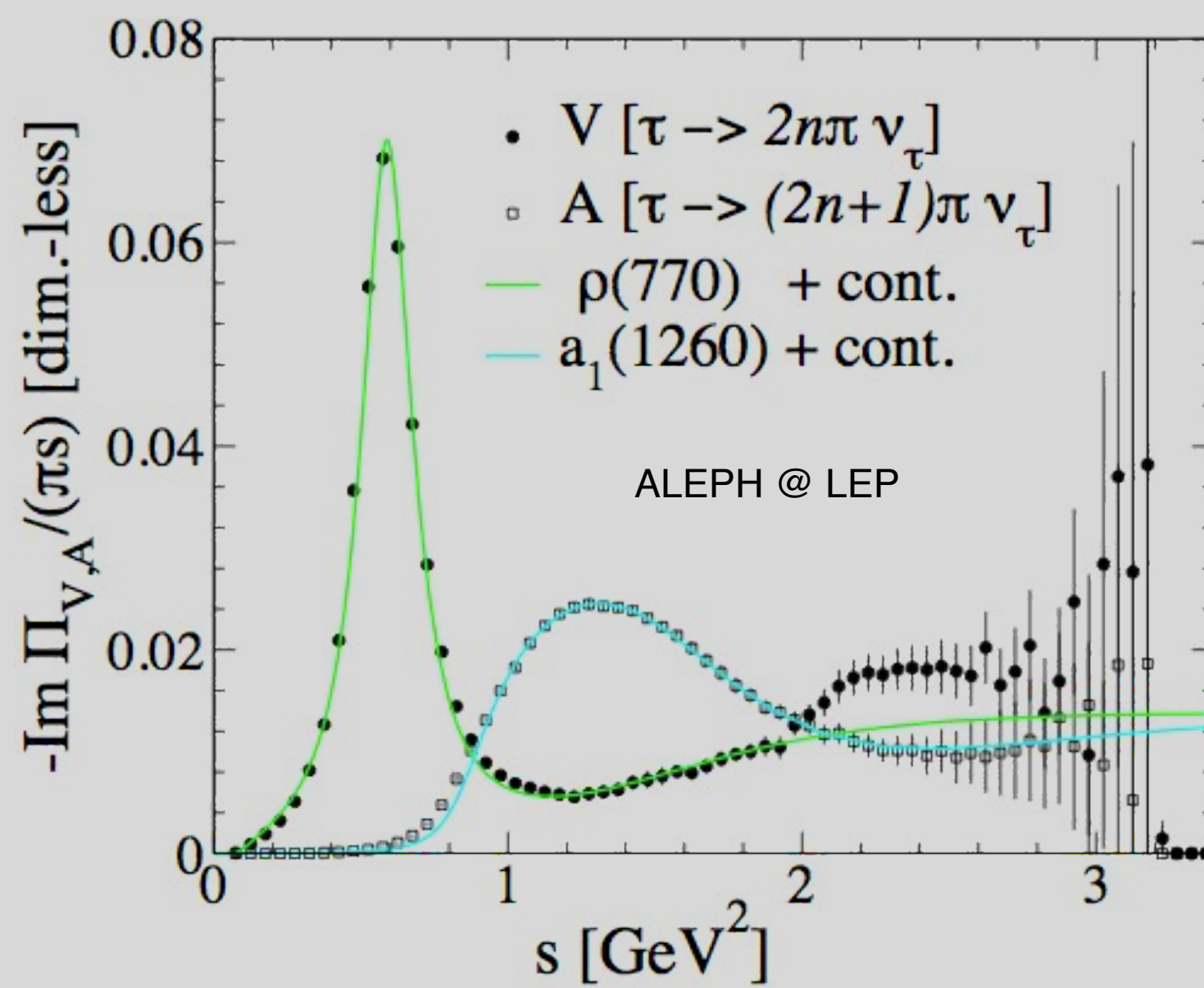
### Dynamic information about HIC stages encoded in dilepton invariant mass

- Low-Mass-Region: vector meson properties &  $\chi$ SR
- Intermediate-Mass-Region: initial QGP temperature via thermal radiation

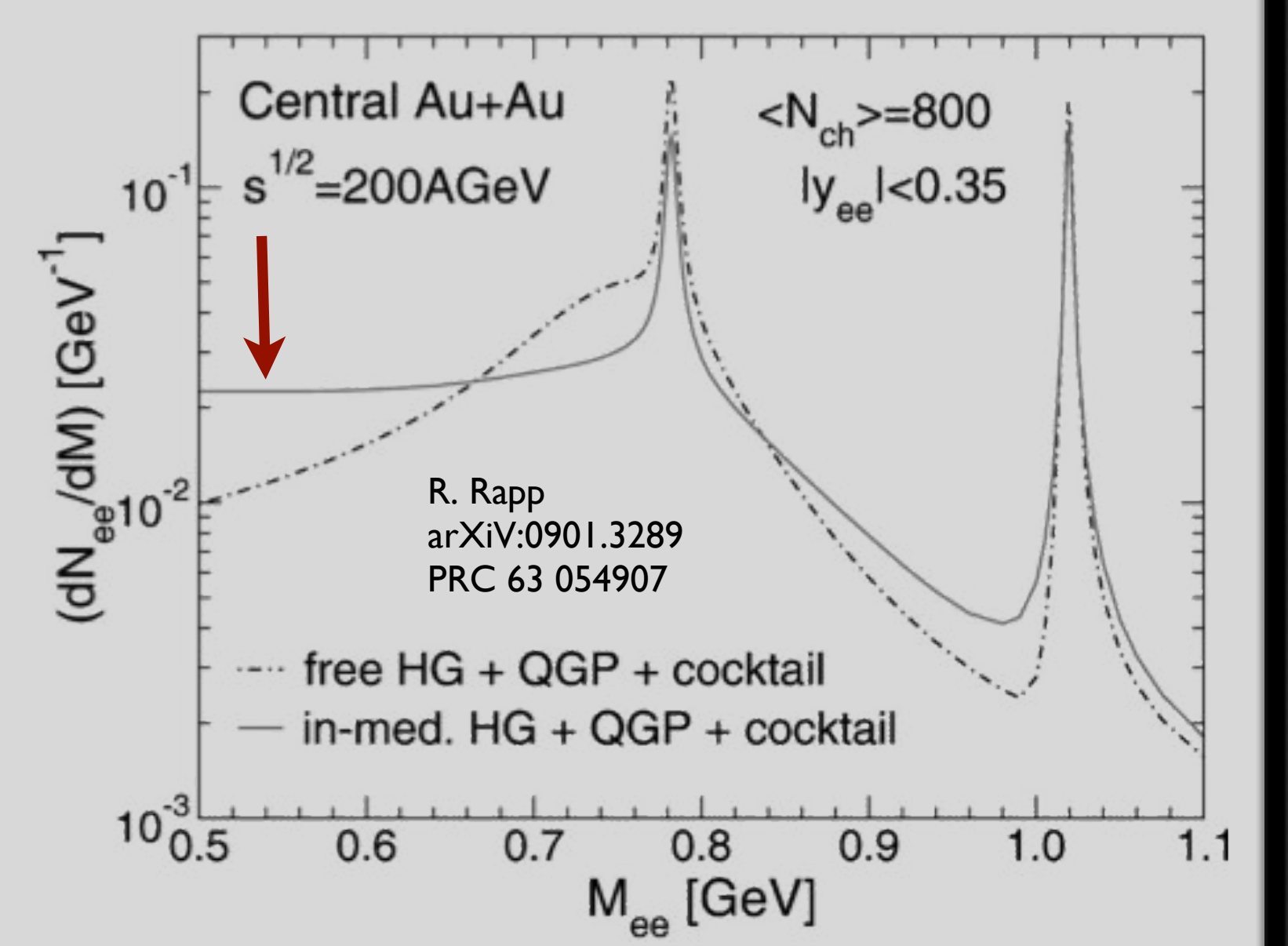
### Effective Model of Hadronic Multi-Body Interactions in hot & dense HGP

- factor 2 enhancement in Low-Mass-Region around 0.5 GeV/ $c^2$
- possible connection to  $\chi$ SR through reduced duality threshold

### non-degenerate hadronic Isospin Doublets



### $e^+e^-$ Spectrum after Fireball Evolution



Excellent  $e^+e^-$  identification with large acceptance via **Time-Of-Flight Detector & Time Projection Chamber** in the high-statistics runs of 2010:

Energy	19.6 GeV	39 GeV	62.4 GeV	200 GeV
used MB Evt	35.8 M	99.4 M	54.6 M	240 M

## Background Subtraction

$e^+e^-$  created in pairs  $\Rightarrow$  unlike-sign BG is *geometric mean* of the like-sign BGs independent of primary probability/multiplicity distribution  $\langle \text{BG}_{+-} \rangle = 2\sqrt{\langle \text{BG}_{++} \rangle \langle \text{BG}_{--} \rangle}$

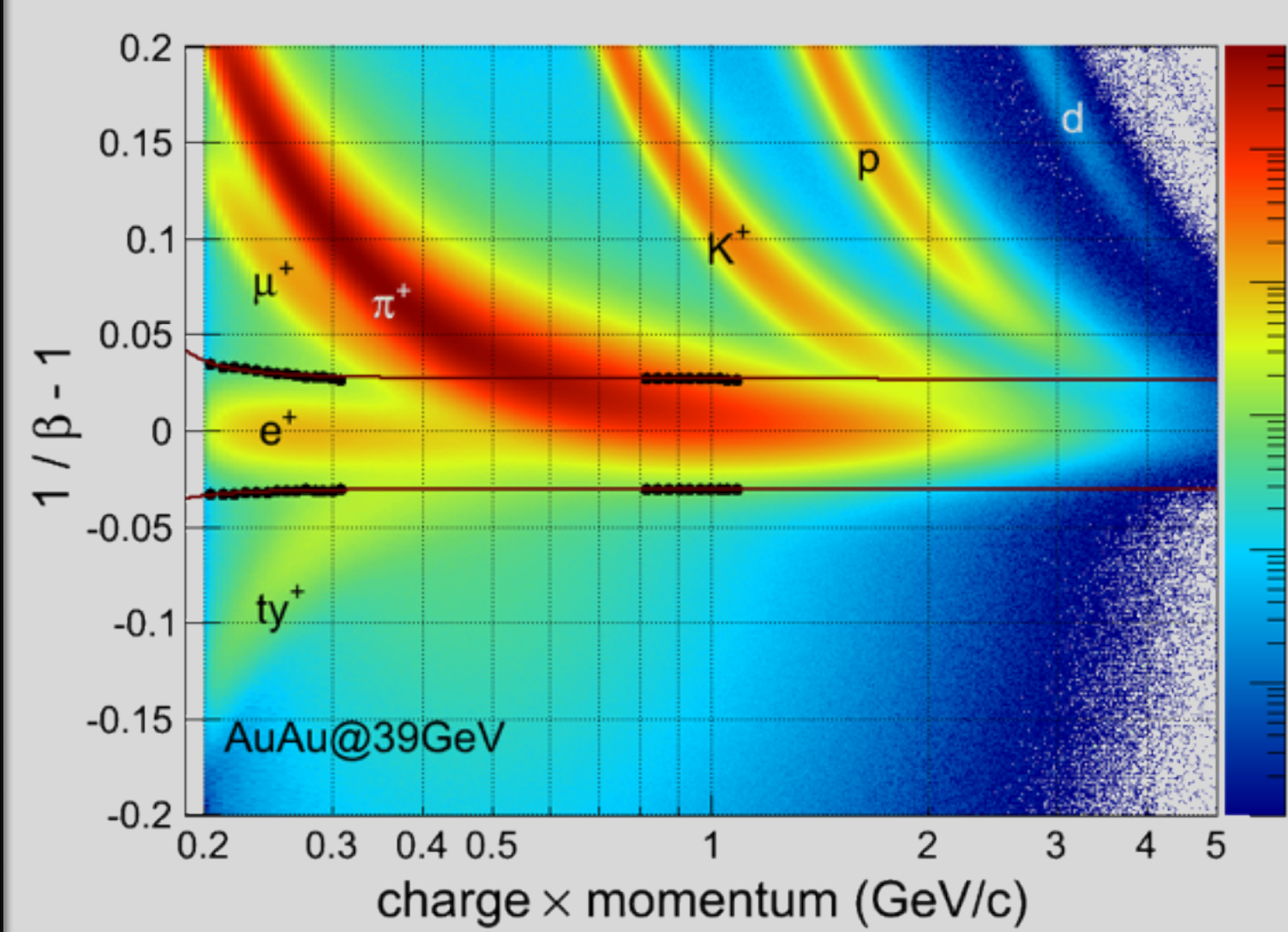
### Like-Sign Same Event Method

- All like-sign pairs of one event combined & averaged
- Method reproduces BG from all correlated sources
- Acceptance difference of like-sign to unlike-sign pairs is corrected using the ME Technique

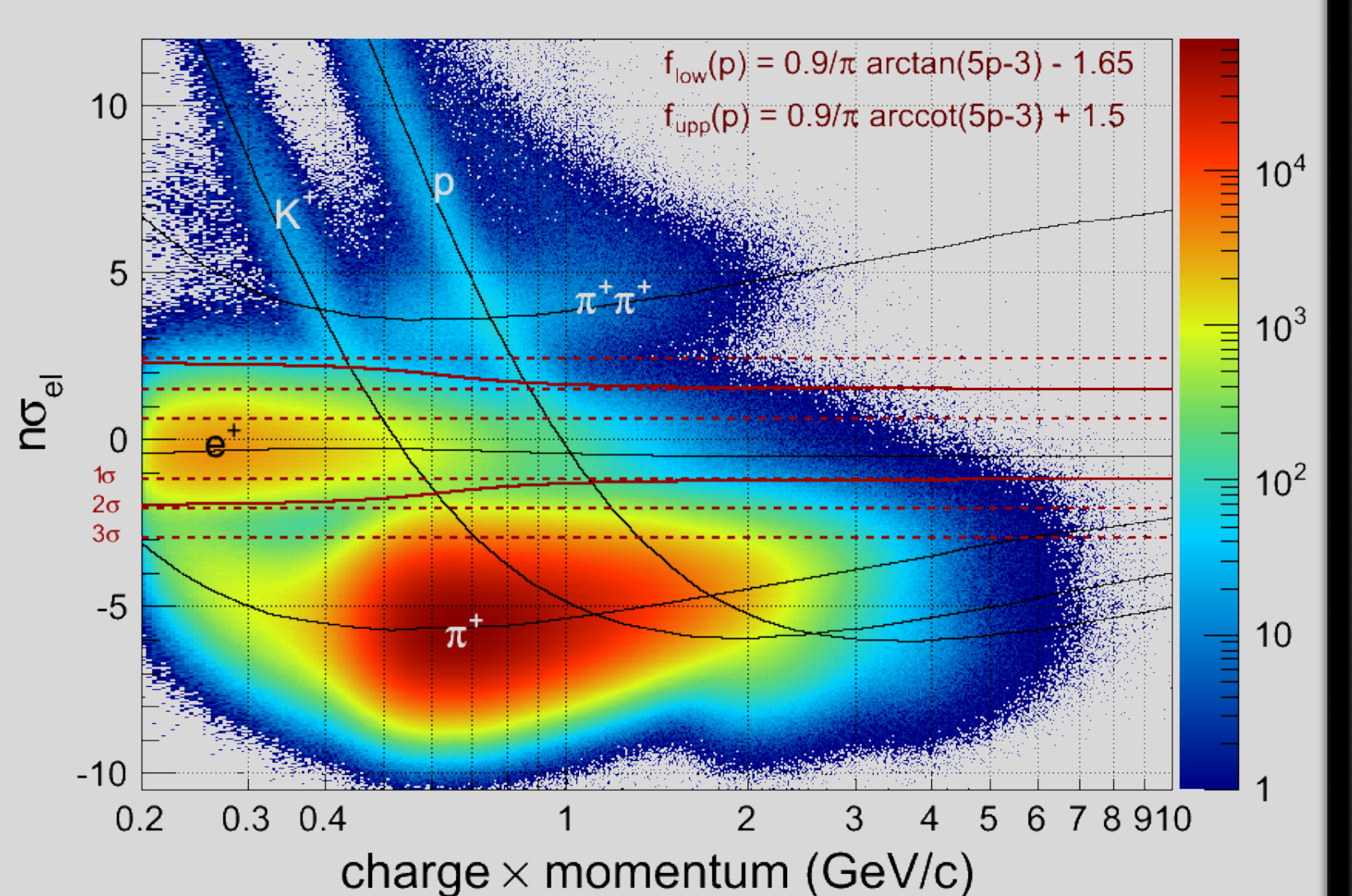
### Unlike-Sign Mixed Event Method

- Charges from two different events within same event class are combined (event vertex, ref. multiplicity & event plane)
- Method describes uncorrelated BG only

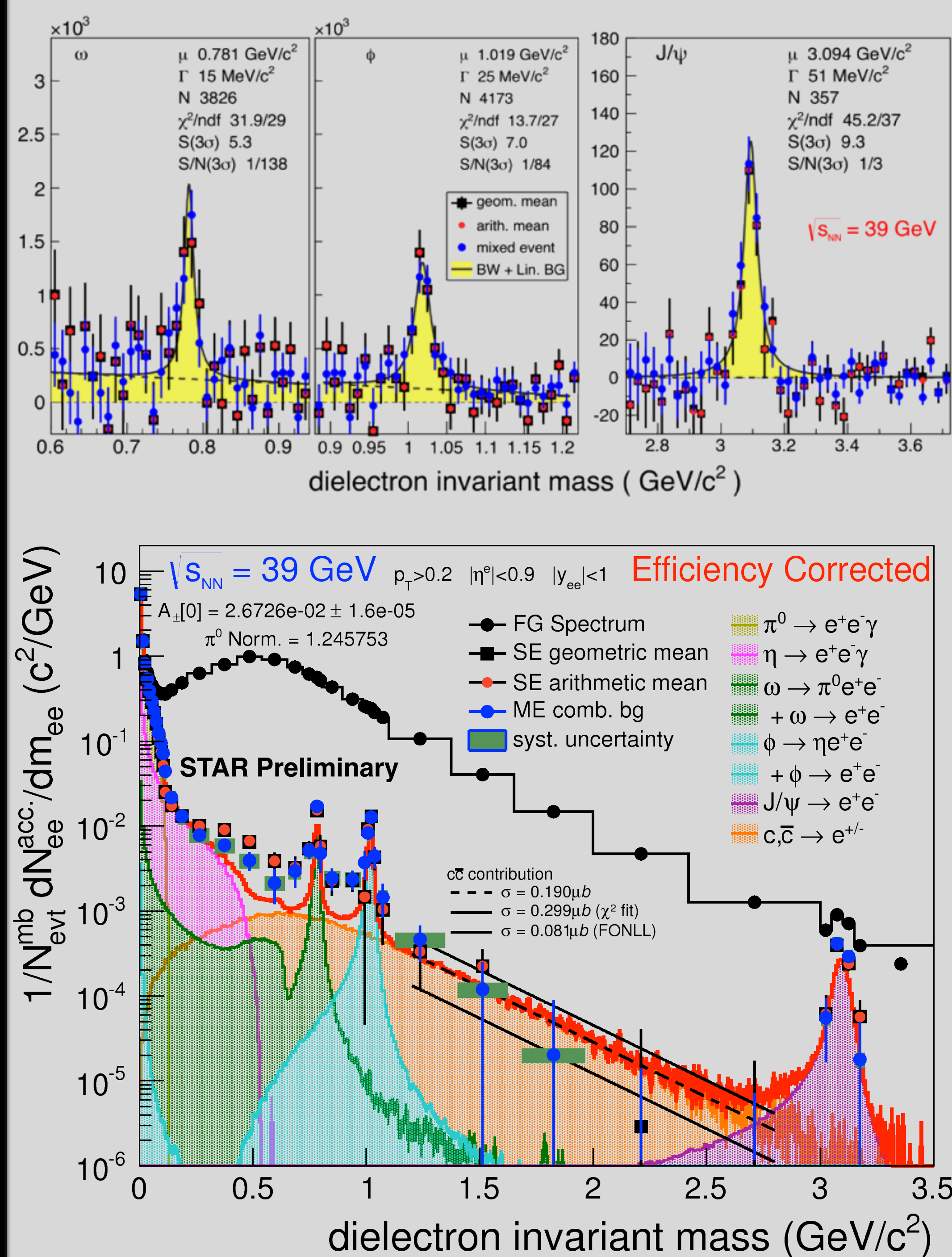
## Electron Identification



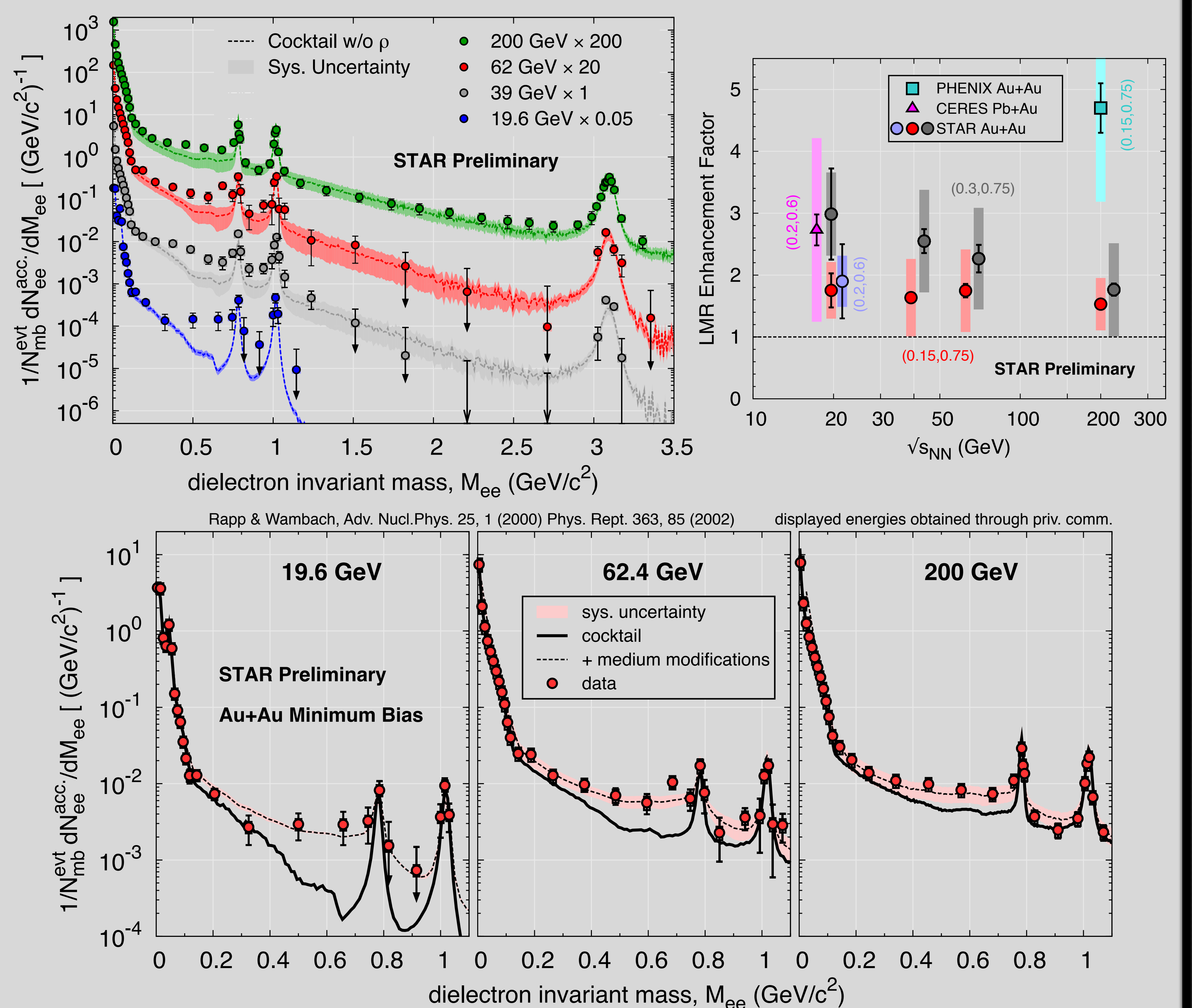
$$n\sigma_{el} \propto \ln \left( \frac{dE/dx|_{\text{meas}}}{dE/dx|_{\text{electron}}} \right)$$



## Dielectron Invariant Mass Spectra



## RESULTS: Energy-Dependent Measurements of Dielectron Production



## Outlook

- extend study to all BES energies measured by STAR
- include  $p_T$  and centrality dependencies to further improve the understanding of the underlying LMR excess source
- charm continuum contribution and its possible in-medium modification need better understanding in Au+Au  $\Rightarrow$  STAR HFT & MTD upgrades.

- Dielectron invariant mass spectra from Au+Au collisions systematically measured in STAR at  $\sqrt{s_{\text{NN}}} = 19.6, 39, 62.4$  & 200 GeV
- visible LMR excess over hadronic cocktail (excl.  $\rho \rightarrow e^+e^-$ ) observed from SPS up to top RHIC energies
- results suggestive of decreasing LMR enhancement with increasing energy
- within systematic uncertainties, in-medium modifications to the  $\rho$  spectral function consistently describe the LMR excess yield over a wide range of energies